HYBRIDIZATION WITHIN THE TRITICEAE OF ALASKA: A NEW × ELYHORDEUM AND COMMENTS.

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Frequent intergeneric hybridization between members of the Triticeae has led some taxonomists to reconsider generic affiliations in this group. Löve and Löve (1965) recently included in the genus *Elymus* the members of *Agropyron* referred to *Roegneria* by some authors, at the same time transferring *Elymus arenarius* L. and its relatives from *Elymus* to *Leymus*. A number of these grasses occur in Alaska, and their crossing relations are pertinent to the proposed taxonomic realignment. This paper reports on an additional intergeneric cross in the Triticeae, summarizes the recorded crosses involving Alaskan Triticeae, and comments on the above realignment.

Plants found at two locations in the vicinity of Palmer, Alaska, are apparent hybrids of *Elymus sibiricus* L. and *Hordeum jubatum* L. The inflorescence of the hybrid has the general appearance of *H. jubatum* but is more nodding with shorter awns that become curved and divergent upon drying. The nodding habit of the inflorescence is not as extreme, however, as in *E. sibiricus* (Fig. 1). Under favorable growing conditions the plant is broadly tussocked and leafy and produces numerous flowering culms.

The characteristics of *Hordeum* are expressed in the possession of (i) 3 spikelets at a node, the laterals being subsessile, (ii) awnlike glumes, and (iii) a tendency to disarticulation of the main rachis. The *Elymus* influence is evident in a plurality of well-developed florets in all 3 spikelets on some of the plants and the occurrence of 3 spikelets at a node (instead of 1 or 2, which is characteristic of the × *Agrohordeum* hybrids).

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Plate 1398.

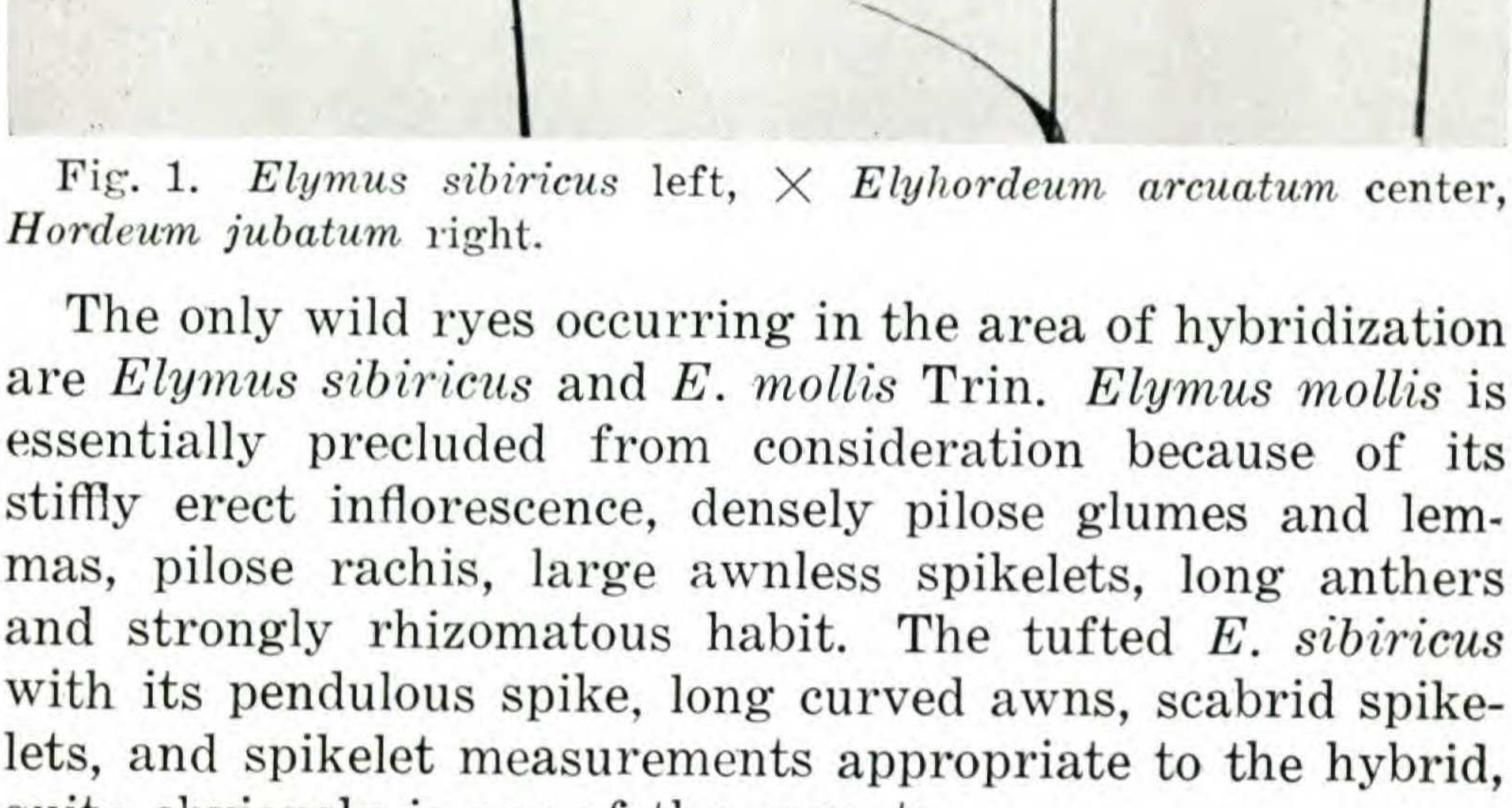

Fig. 1. *Elymus sibiricus* left, × *Elyhordeum arcuatum* center, *Hordeum jubatum* right.

The only wild ryes occurring in the area of hybridization are *Elymus sibiricus* and *E. mollis* Trin. *Elymus mollis* is essentially precluded from consideration because of its stiffly erect inflorescence, densely pilose glumes and lemmas, pilose rachis, large awnless spikelets, long anthers and strongly rhizomatous habit. The tufted *E. sibiricus* with its pendulous spike, long curved awns, scabrid spikelets, and spikelet measurements appropriate to the hybrid, quite obviously is one of the parents.

Both the long-awned *Hordeum jubatum* and short-awned *H. brachyantherum* Nevski occur in the area and possess characters pertinent to the hybrid. Some characteristics of the taxa under consideration are compared in Table 1.

Conceivably, either species of *Hordeum* could have combined with *E. sibiricus* to produce the hybrid. However, the long-barbed prickes and pilose leaf surface of the hybrid definitely favor *H. jubatum* over *H. brachyantherum*. Moreover, anther length of the hybrid tends to be intermediate between those of *H. jubatum* and *E. sibiricus*.

CYTOLOGICAL OBSERVATIONS.

The results of meiotic studies are summarized in Table 2. Both parents and the hybrid are tetraploids ($2n=28$).

TABLE 1.

Some morphological comparisons of × *Elyhordeum arcuatum* and its possible parents

	Hordeum brachyantherum	*Hordeum jubatum*	× *Elyhordeum arcuatum*	*Elymus sibiricus*
lemma (mm)	6.5-10	5-7.5	9-11	9.5-14.2
lemma-awn (mm)	6-15	35-75	17-25	11.5-31
anther (mm)	1.3-1.8	0.8-1.4	1.0-1.5	1.4-1.9
abaxial surface of flag leaf	glabrous	often pilose	pilose	glabrous to pilose
abaxial surface of flag leaf	with scattered, short-barbed prickles	densely scabrid with long-barbed prickles	scabrid with short to long-barbed prickles	smooth to scabrid with short-barbed prickles

All cells viewed bore univalents varying in number up to 14. Generally 5 to 8 bivalents were present in a cell, and about one-half of the cells contained multivalents. Anaphase I figures contained from 7 to 16 laggards, and all 242 quartets observed bore micronuclei. The frequency of pairing and multivalent formation indicates some homology between one set of genomes as well as the occurrence of translocations in the differentiation of the genomes. Pollen

TABLE 2.

Observations of meiosis in × *Elyhordeum arcuatum*

Stage of Meiosis	No. Cells Observed	Univalents	Bivalents	Multivalents	Laggards
Metaphase I	23	245	126	11	
Anaphase I	24				311
Average per cell		10.7	5.5	0.5	12.7

grains accepted a light stain in aniline blue but not the deep granular stain of normal pollen. The hybrid appears completely sterile.

DESCRIPTION OF HYBRID.

× **Elyhordeum arcuatum** Mitchell & Hodgson, hybr. nov. Fig. 1.

(Putative parents: *Elymus sibiricus* L. × *Hordeum jubatum* L.)

Gramen perenne, caespitosum; culmi 40-85 cm alti 2-4 nodis; folia pilosa supra, scabra infra, 3-10 mm lata, 7-22 cm longa; spica arcuata, nutans, 6-15 cm longa; spiculae 3 ad nodum; spicula centralis 1-3 flosculis, sessilis; spiculae laterales 0-2 flosculis, subsessiles; flosculi steriles; glumae scabrae, aristiformes, usque ad 25 mm longae; lemmata scabra, 9-11 mm longa, aristis usque ad 25 mm longis; aristae curvantes ubi siccae; antherae 1.0-1.4 mm longae; $2n=28$.

HOLOTYPE: Roadside at junction of Fireweed Avenue and the Alaska railroad in Palmer, Alaska, 27 Jul 63, *Mitchell & Hodgson 980*, (ALA); isotypes (AES), (US), (ISC). Waste area at east end of east-west runway, Palmer, Alaska airfield, 23 Sep 64, *Mitchell & Hodgson 923A1*, paratype (AES). Experimental garden, Alaska Agricultural Experiment Station, Palmer, 4 Jul 67, *Mitchell 74D1*, *Mitchell 74D2*, paratypes (AES).

DISCUSSION.

An interesting pattern of intergeneric hybrid links has emerged from recorded crosses within the Triticeae of Alaska (Lepage 1952; Bowden 1958; Hodgson 1964; Hodgson and Mitchell 1965; Mitchell and Hodgson 1965) as illustrated in Figure 2. A number of reported crosses, that as yet have not been observed in Alaska, are also designated for species that are nevertheless represented in the state (Stebbins, et al. 1946a, 1946b; Lepage 1952, 1957; Bowden 1958, 1959). These are denoted by dashed lines in Figure 2. See Bowden (1967) for an excellent review of the intergeneric hybrids of the Triticeae of North America.

In the proposed reclassification of the taxa of Figure 2 (Löve and Löve 1965) *Elymus mollis* and *E. innovatus* Beal would be placed in *Leymus* and the wheat-grasses *Agropyron sericeum* Hitchc., *A. trachycaulum* (Link) Malte, and *A. violaceum* (Hornemann) Lange (= *A. latiglume* (Scribn. & Smith) Rydb.) combined with the wild ryes *Elymus sibiricus*, *E. glaucus* Buckley and *E. hirsutus* Presl.

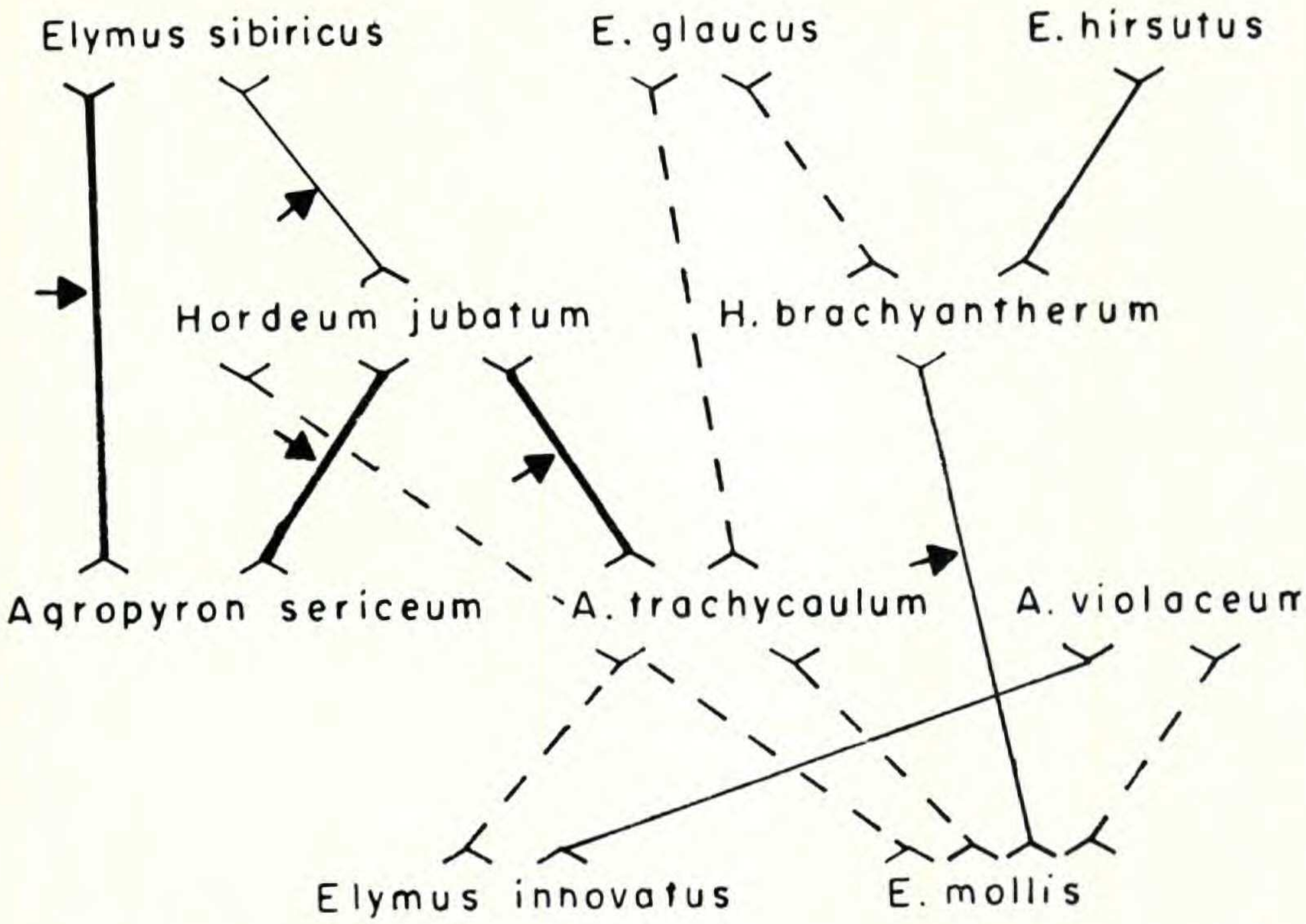

Fig. 2. Summary of intergeneric hybridization recorded for the Triticeae of Alaska. Heavy lines denote frequent occurrences, thin lines infrequent occurrences, and dashed lines recorded crosses not yet observed in Alaska. Five of the crosses, indicated by arrows, were observed in the vicinity of Palmer, Alaska.

under *Elymus*. Relationships expressed in Figure 2 indicate, however, an affinity between *Hordeum jubatum* and members of *Agropyron* which is as close as that between *Agropyron* and *Elymus*. Indeed, *Hordeum jubatum* and its close relative *H. brachyantherum*, which hybridize (Bowden 1962; Mitchell and Wilton 1964), serve as a hub relating all the taxa.

In none of the instances observed has the ability to cross appeared to have led to intergeneric introgression, this apparently being blocked by hybrid sterility. But the possibility of its occurring is not precluded, since colchicine treatment of × *Agroelymus palmerensis* Lepage *(Agropyron sericeum* × *Elymus sibiricus)* has demonstrated that fertility may be established in the allopolyploids. A wide array of recombinants has been produced through the C_3

generation from open pollination of fertile octoploids (Hodgson, unpublished data).

The incompleteness of the reproductive barriers between members of this generic complex, embracing as it does such morphologically disparate groups, seemingly confounds any attempt at a wholly satisfactory classification of the complex. Nevertheless, we consider it noteworthy that the character difference employed to discriminate *Agropyron* and *Elymus* is sufficiently strong to be reflected in crosses involving members of both genera with the same species, *Hordeum jubatum*. × *Agrohordeum* hybrids of this cross bear 1 to 2 spikelets at most nodes, rarely 3, while × *Elyhordeum* hybrids bear 3 well developed spikelets at a node.[1]

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[1]See Bowden (1958) and Pohl (1966) for other *Elymus* spp. × *Hordeum jubatum* crosses not cited in this paper.

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